Claims

1) A liquid dispenser comprising:

a pump housing having a liquid pump chamber and an air pump chamber;

a pump plunger in the pump housing, the pump plunger having a center axis that defines mutually perpendicular axial and radial directions and the pump plunger having an interior discharge passage that extends axially through the pump plunger;

a liquid piston on the pump plunger and positioned in the liquid pump chamber defining an interior volume of the liquid pump chamber, the liquid piston being moveable between charge and discharge positions in the liquid pump chamber where the liquid piston respectively increases and decreases the interior volume of the liquid pump chamber;

an air piston on the pump plunger and positioned in the air pump chamber defining an interior volume of the air pump chamber, the air piston being moveable between charge and discharge positions in the air pump chamber where the air piston respectively increases and decreases the interior volume of the air pump chamber, and the air piston being moveable with respect to the pump plunger between vent open and vent closed positions of the air piston relative to the pump plunger where in the vent open position of the air piston the air pump chamber is vented to an exterior environment of the dispenser to vent air to the air pump chamber interior volume and in the vent closed position of the air piston the air pump chamber is sealed closed from the exterior environment of the dispenser.

2) The dispenser of Claim 1, further comprising:

the air piston being mounted on the pump plunger for limited axial movement of the air piston between the vent open position and the vent closed position of the air piston relative to the pump plunger.

3) The dispenser of Claim 1, further comprising:

a vent hole passing through the air piston;

the pump plunger extending through the air piston vent hole, the air piston vent hole defining a venting air flow path between the plunger and the air piston that vents the air pump chamber interior volume to the exterior environment of the dispenser when the air piston is moved to the vent open position relative to the pump plunger.

4) The dispenser of Claim 1, further comprising:

a hole passing through the air piston;

the pump plunger extending through the air piston hole thereby mounting the air piston on the pump plunger for movement of the air piston between the vent open and vent closed positions of the air piston relative to the pump plunger;

a first projection on the pump plunger on one side of the air piston;

a second projection on the pump plunger spaced axially from the first projection on an opposite side of the air piston from the first projection, the first projection and second projection limiting the movement of the air piston relative to the pump plunger in the axial spacing between the first projection and second projection.

5) The dispenser of Claim 4, further comprising:

the air piston hole defining a vent air flow path between the plunger and the air piston that vents the air pump chamber interior volume to an exterior environment of the dispenser when the vent piston is moved to the vent open position relative to the pump plunger; and,

the first projection being positioned on the plunger to engage with the air piston and close the air piston hole and the vent air flow path when the air piston is moved to the vent closed position relative to the pump plunger.

6) The dispenser of Claim 5, further comprising:

the first projection being an annular stopper that extends around the pump plunger and is positioned to engage in the air piston hole when the air piston is in the vent closed position relative to the plunger to close the air piston hole.

7) The dispenser of Claim 5 further comprising:

the second projection being positioned on the pump plunger to engage with the air piston when the air piston is moved to the vent open position relative to the pump plunger to stop movement of the air piston and keep open the vent air flow path between the pump plunger and the air piston.

8) The dispenser of Claim 5, further comprising:

the second projection being one of a plurality of second projections on the pump plunger, the plurality of second projections being spatially arranged around the pump plunger in positions to engage the air piston when the air piston is moved to the vent open position and to keep open the vent air flow path between the pump plunger and the air piston.

9) The dispenser of Claim 3, further comprising:

the vent hole being the only hole through the air piston.

10) The dispenser of Claim 3, further comprising:

the liquid piston being mounted on the pump plunger for limited axial movement of the liquid piston relative to the pump plunger.

11) The dispenser of Claim 10, further comprising:

a liquid pump chamber outlet valve positioned in the pump plunger discharge passage to control a flow of liquid out of the liquid pump chamber and through the pump plunger discharge passage, the outlet valve being separate from the liquid piston.

12) A liquid dispenser comprising:

a pump housing having a liquid pump chamber and an air pump chamber;

a pump plunger mounted on the pump housing for reciprocating movement between an extended and a retracted position of the pump plunger relative to the pump housing, the pump plunger having a center axis that defines mutually perpendicular axial and radial directions and the pump plunger having an interior discharge passage that extends axially through the pump plunger;

a liquid piston on the pump plunger and positioned in the liquid pump chamber defining an interior volume of the liquid pump chamber, the liquid piston being moveable between charge and discharge positions in the liquid pump chamber in response to the pump plunger moving between the respective extended and retracted positions, where the liquid piston increases

and decreases the interior volume of the liquid pump chamber when moved to the respective charge and discharge positions;

an air piston on the pump plunger and positioned in the air pump chamber defining an interior volume of the air pump chamber, the air piston being moveable between charge and discharge positions in the air pump chamber in response to the pump plunger moving between the respective extended and retracted positions, where the air piston increases and decreases the interior volume of the air pump chamber when moved to the respective charge and discharge positions;

a vent hole in the air piston, the vent hole defining a vent air flow path from the interior volume of the air pump chamber through the vent hole to an exterior environment of the dispenser; and,

a projection positioned on the plunger to open the air piston vent hole in response to the pump plunger being moved to the extended position and to close the vent hole in response to the pump plunger being moved to the retracted position.

13) The dispenser of Claim 12, further comprising:

the air piston being mounted on the pump plunger for axial movement of the air piston between vent open and vent closed positions of the air piston relative to the pump plunger in response to the pump plunger being moved between the respective extended and retracted positions, the projection on the pump plunger being displaced from the air piston vent hole in the vent open position of the air piston, and the projection on the pump plunger closing the air piston vent hole in the vent closed position of the air piston.

14) The dispenser of Claim 12, further comprising:

the pump plunger extending through the air piston vent hole whereby the air piston is mounted on the pump plunger.

15) The dispenser of Claim 14, further comprising:

the projection on the pump plunger being an annular projection that extends around the pump plunger and is positioned on the plunger to seat over the air piston vent hole to close the vent hole.

16) The dispenser of Claim 15, further comprising:

the annular projection unseating from the air piston vent hole in response to the pump plunger being moved to the extended position and thereby establishing a vent air flow path from the air pump chamber interior volume and through a radial spacing between the pump plunger and the air piston to an exterior environment of the dispenser.

17) The dispenser of Claim 15, further comprising:

the annular projection being on one side of the air piston and a second projection on an opposite side of the air piston from the annular projection, the annular projection and the second projection enabling limited axial movement of the air piston relative to the pump plunger between the annular projection and the second projection.

18) The dispenser of Claim 17, further comprising:

the second projection being one of a plurality of second projections spacially arranged around the pump plunger in positions to engage with the air piston in the vent open position of the air piston and establish a vent air

flow path between the pump plunger and the air piston venting the air pump chamber interior volume to an exterior environment of the dispenser.

19) The dispenser of Claim 12, further comprising:

the liquid piston being mounted on the pump plunger for limited axial movement of the liquid piston relative to the pump plunger.

20) The dispenser of Claim 14, further comprising:

the air piston vent hole being the only hole through the air piston.